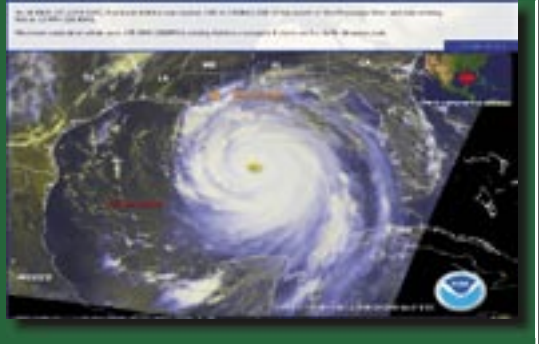
Project Leader's Special Report

August 2005

USDA Forest Service - Southern Research Station - 320 Green Street Athens GA 30602 - http://www.srs.fs.fed.us/disturbance

DISTURBANCE AND MANAGEMENT OF SOUTHERN ECOSYSTEMS

The end of the month was a scramble with Hurricane Katrina disrupting communications and wreaking havoc on the Gulf Coast. In this special Science Highlight, we try to pull together information that provides a bit of a longer-term view than is appearing on the cable news channels. Many people contributed to this special issue; some contributed directly but more contributions were made indirectly, through scientists who studied and reported on hurricanes and their effects on southern forests.



In the early afternoon of August 28, 2005 Hurricane Katrina was a Category 5 event with sustained winds of 175 mph, aimed for New Orleans. (Satellite image from NOAA)

Science Highlight-Hurricane Katrina:

More than 120 hurricanes have made landfall in the southern US since the 1880s. Major storms hit southern Louisiana in 1915, 1947, 1948, 1969, 1992, 1998, and 2004. On average since 1871, a hurricane makes landfall somewhere in Louisiana about every 2.8 years. (Map US Forest Service)

Hurricanes are a fact of life in the South and the past 10 hurricane seasons have been the most active on record. Many climatologists say the trend toward greater hurricane activity could persist for another 20 years or more, caused by changes in the natural salinity and temperature of the Atlantic's deep current circulation, elements that shift back and forth every 40 to 60 years. Hurricane Katrina hit the Gulf Coast this month, causing what has been termed the most costly natural disaster in U.S. history. In addition to the wind, storm surge, and flooding damage on the Gulf Coast in Louisiana, Mississippi, and Alabama, levees surrounding New Orleans were undermined and collapsed causing extensive flooding damage. The accompanying graphic from the British Broadcasting Corporation illustrates the "soup bowl" shape of New Orleans that contributed to the problem (see story at http://news.bbc.co.uk/go/em/fr/-/1/hi/world/americas/4201060.stm). Two Southern Station locations were directly in harms way, our Tax and Policy Office in New Orleans and our Genetics Lab in Saucier, Mississippi. In addition, four Forest Inventory and Analysis (FIA) employees holding temporary duty locations in Mississippi were affected. Within our unit, Lynne Breland works remotely from the St. Catherine Creek National Wildlife Refuge near Natchez, Mississippi and lost power and telephone service.

From a Class 5 hurricane with maximum sustained winds of 175 mph in the Gulf, Katrina had abated to a Class 4 when it slammed into lower Louisiana and then Mississippi. In comparison to Hurricane Ivan, the width of hurricane force winds (minimum sustained speed of 75 mph) at landfall was 18% wider and Katrina's hurricane force winds persisted 36% further inland than did Ivan. Tropical storm force winds (minimum sustained winds of 40 mph) were 27% wider and persisted approximately 96% further inland than for Ivan. These values were determined by visual inspection and measurements on similar images

These images depict the topography of New Orleands and eplain why some portions of the city flooded so deeply after the protecting levees were breached by the storm surge and failed. (Graphic from British Broadcasting Corporation web site)

Science Highlight-Hurricane Katrina:

A coastal plain pine stand damaged by winds from Hurricane Hugo, which came ashore near Charleston, South Carolina in September 1989. (Photo US Forest Service)

by Scott Goodrick in our unit. Putting Katrina into perspective, she caused devastation over an area of almost 90,000 square miles—an area larger than Great Britain.

Hurricane Katrina has fed the controversy over a possible link between climate change and increasing severity of hurricanes and cyclones. One study recently published in Nature showed an increase in the duration and intensity of major storms since the 1970s in the Atlantic and Pacific. Other experts recognize the warming trend in sea surface temperatures that drive these events, but attribute the trend to normal environmental variation rather than a link to global warming. Nevertheless, the consensus is that we are in for more severe hurricanes over the next two decades.

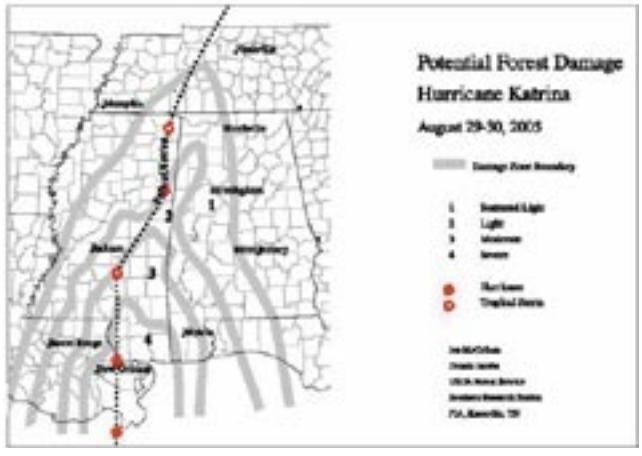
The human toll from Katrina is inestimable and the nature of the emergency response will be debated for some time to come. Although we do not have precise estimates of direct and indirect damage and economic effects of this major event, the estimated economic loss from damage to timber is from $1.4 billion to $2.4 billion; approximately 67% of the damages are found in Mississippi (damage estimated from Forest Inventory and Analysis estimates of wind damaged stands and economic value estimated by SRS economists Jeff Prestemon and Dave Wear). Salvage operations may recover some of this lost value; however experience following Hurricane Hugo suggests this may be small. After Hugo, about 37% of volume but only about 10% of value was recovered by the salvage operation. Studies of other disasters show that prices may be elevated in the region for 5-15 years after the initial salvage, which could mitigate some of the damages suffered in the short run.

Although the human cost of Katrina cannot be measured, perhaps it is not too early to try to understand the effects this event will have on southern forest ecosystems. We may be able to point toward some lessons to be learned in terms of adaptive forest management. It may be easiest to think separately about the coastal pine forests versus the coastal bottomland hardwood and cypress swamp forests. The immediate concern in the pine forests will be the amount and flammability of downed material. Potential salvage will be constrained by manpower needs for other recovery efforts, safety of woods workers in the damaged stands, the poor quality of severely damaged trees, and the rapid development of fungal stains in the wood that further degrade quality. There is also the further effect of large amounts of wood on the market depressing stumpage prices, which decreases the economic incentive for salvage. There will still be a need to reduce levels of potentially hazardous fuels. One possible use would be co-generation in power utility plants but unless facilities are already equipped to handle woody biomass, this is not a short-term solution. But it should spur development of in-woods bio-processing capability, technology that can convert woody biomass in the forest into higher-valued liquid fuels that are more easily transported.

Hurricane Katrina made landfall on the Louisiana and Mississippi coasts as a Category 4 Hurricane. As the storm moved inland, winds abated to tropical storm levels, reaching almost to the Tennessee-Kentucky border. (Maps from NOAA website)

A practical method for disposing of the massive amounts of forest and urban debris will be outdoor burning, which causes smoke that can obstruct vision on highways and add to the health burden of sensitive groups in local populations. Smoke models developed by research can help by modeling smoke development and transport, providing guidance on safe conditions for burning, especially in coastal areas where sea breezes make prediction of smoke movement very difficult. Because the clean-up period will last for some time, the need for smoke modeling will be ongoing. There is also concern about emissions from prescribed fires on timberland that may be contaminated by toxic chemicals and other waste. We have local and regional models of smoke movement capable of predicting where these products will be transported over a period of several days. These models can help select burn days when the smoke will be transported out to sea or over sparsely populated land areas, thus avoiding population centers.

Existing research about the rates of stand rehabilitation and recovery in naturally-regenerated pine stands affected by wind damage can give some 'adaptive management' guidance about how to proceed in hurricane damaged stands, by basing that decision on the given level of stocking and condition of the surviving trees in the stand. This would allow prioritization of what is likely to be a limited budget for stand re-establishment efforts, directing reforestation treatments to those sites where rehabilitation seems less likely to occur. On public lands and Non-Industrial Private Forest (NIPF) lands, and to a lesser extent on industry lands, naturally-regenerated stands



Early estimates of damage to timber resources from Hurricane Katrina are based on standing volumes, stand age and composition, and approximate wind speeds. (Map US Forest Service)

can quickly recover from more under-stocked conditions than most people think. Loblolly pine responds rapidly to release at advanced age, and can often be restored to full-stocking from stocking levels as low as 30% of full-stocking more rapidly by managing the existing stand than by starting over. Surviving trees with at least 20% live crown ratio, not flat-topped, and at least 2 inches in diameter at the base of the live crown can survive and rebuild new crowns. For young pine plantations, there will be bending and breaking and the question will be whether to replant or let the stand continue to develop. Based on work done after Hurricane Hugo in South Carolina, pine trees of any age with > 45 degrees of lean, and trees age 8 and older with > 25 degrees of lean, should probably be harvested and replanted immediately after storm damage. These trees will grow significantly slower, and be undesirable for solid wood products because of a higher proportion of compression wood. Any trees with less than 25 degrees of lean, and trees age 4 or less with less than 45 degrees of lean, will recover from storm induced lean and produce wood with properties acceptable for producing solid wood products.

The damage to coastal forests presents an opportunity to move toward establishing a forest that is structurally and functionally more suited to the coastal environment. In the recovery of loblolly plantations post-Katrina, we must decide whether to replant loblolly in areas prone to destruction by hurricane or convert stands to the more resilient longleaf pine. For stands that might be slated for conversion from loblolly pine to longleaf pine, it will be critical under many circumstances to act quickly to remove any salvageable timber and burn the site to retard natural loblolly regeneration before planting longleaf pine. On the other hand, areas previously dominated by longleaf may contain sufficient advance longleaf regeneration but very little loblolly that site treatments can be delayed. Available research can provide guidance on prioritizing sites for treatments, as well as guidance on restoration techniques adapted to sites and stand conditions.

Potential wildfire hazards are not a great concern in the wetter bottomland and swamp forests but here, as well as in the pine forests, there is a need to restore damaged ecosystems. The World Conservation Union (IUCN) has proposed an initiative to apply ecosystem management principles to natural disaster prevention and management. Following the Indian Ocean Tsunami, the Millennium Ecosystem Assessment produced clear evidence that ecosystems such as coastal wetlands (marsh and forests) play an important role in mitigating the impact of natural hazards and in reducing vulnerability of human societies to future disasters. According to IUCN, investments in ecosystem management and restoration are key elements of adaptation and disaster prevention and preparedness strategies and can bring real economic benefits in terms of reducing vulnerability and managing risk. In coastal areas of the affected states, there are extensive areas of bottomland hardwood and cypress swamp forests that will have been damaged by wind, heavy rains and flooding, as well as salinity from storm surge. Besides obvious signs of current damage, these stresses will lead to later declines, loss of vigor, and insect and disease problems. Available research can be used to help triage damage conditions by categorizing stands that should be salvaged immediately and restored, stands probably not seriously damaged, or stands that may not appear to be damaged but are likely to develop problems later and should be monitored and treated if problems develop.

Longer-term restoration of especially the Louisiana coastal areas will require major effort to build defensive structures and restore natural sediment replenishment processes. There is also a need to restore coastal forests that can more effectively provide protection inland from storm surges and hurricane winds. The best approach will be a combination of structural and non-structural methods. Too often, the desire to act following natural disasters leads to ill-considered clean-up and restoration activities that cause more damage to aquatic systems than the disaster. For example, Hurricane Katrina may have actually rejuvenated many of the sand-bottom streams in the coastal plain. Heavy-handed salvage and restoration in riparian areas, including road building and debris removal, would damage these wood-starved streams. The National Forests of Mississippi were severely damaged by Katrina, with estimates of from 50% to 80% of the overstory down or damaged. Available research and stream surveys, including watershed analyses of land-use, were conducted pre-hurricane on 256 stream reaches in these forests that could help guide riparian area restoration. Much more could be said about the effects of Hurricane Katrina on natural and urbanized ecosystems of the Gulf Coast; no doubt there will be much commentary as we learn more accurately the extent of damage. *(Contributors to this highlight include Scott Goodrick, Gary Achtemeier, Alex Clark, and Ken Outcalt from the unit; Jim Guldin, Hot Springs; Mel Warrenn, Oxford; Dave Wear, RTP amd the Forest Inventory and Analysis unit.)*

One worry after a hurricane is the amount of combustible material added to the forest floor, which can increase the risk of wildfire. These photos from the Francis Marion National Forest in South Carolina after Hurricane Hugo illustrate a medium level of fuel before and after prescribed burning, and the nature of the fire. (Photos US Forest Service)